Increased Generator Flexibility through Distributed Software and Storage Assets

FERC Software Technical Conference

June 30, 2011

A123 Systems Global Locations

- 2,000+ employees in locations worldwide
- >1,000,000 square feet of manufacturing facilities in United States, China and Korea

Corporate Headquarters, Research and Development

- Waltham, Massachusetts

Systems Design and Manufacturing

- Boston Area (Grid Hardware Systems)
- Livonia & Ann Arbor, Michigan (Automotive Systems and Cells)
- St. Louis, Missouri (Grid Software Systems)

European Sales and Engineering

- Stuttgart, Germany

Battery Components and Cells

- Michigan, USA
- Korea
- China

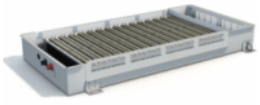
Core Markets

Enabling New Products through Advanced Energy Storage

Transportation

Passenger Hybrids, PHEVs and EVs

Commercial Hybrids, PHEVs and EVs



- Fuel economy
- Reduced emissions
- Energy independence
- Lighter-weight components

Electric Grid

Regulation, Grid Reliability

Renewable Integration, Congestion Relief

- Increase grid reliability
- Enable Wind and Solar
- Increase plant efficiency/utilization

Commercial

IT & Telecomm

Medical Systems

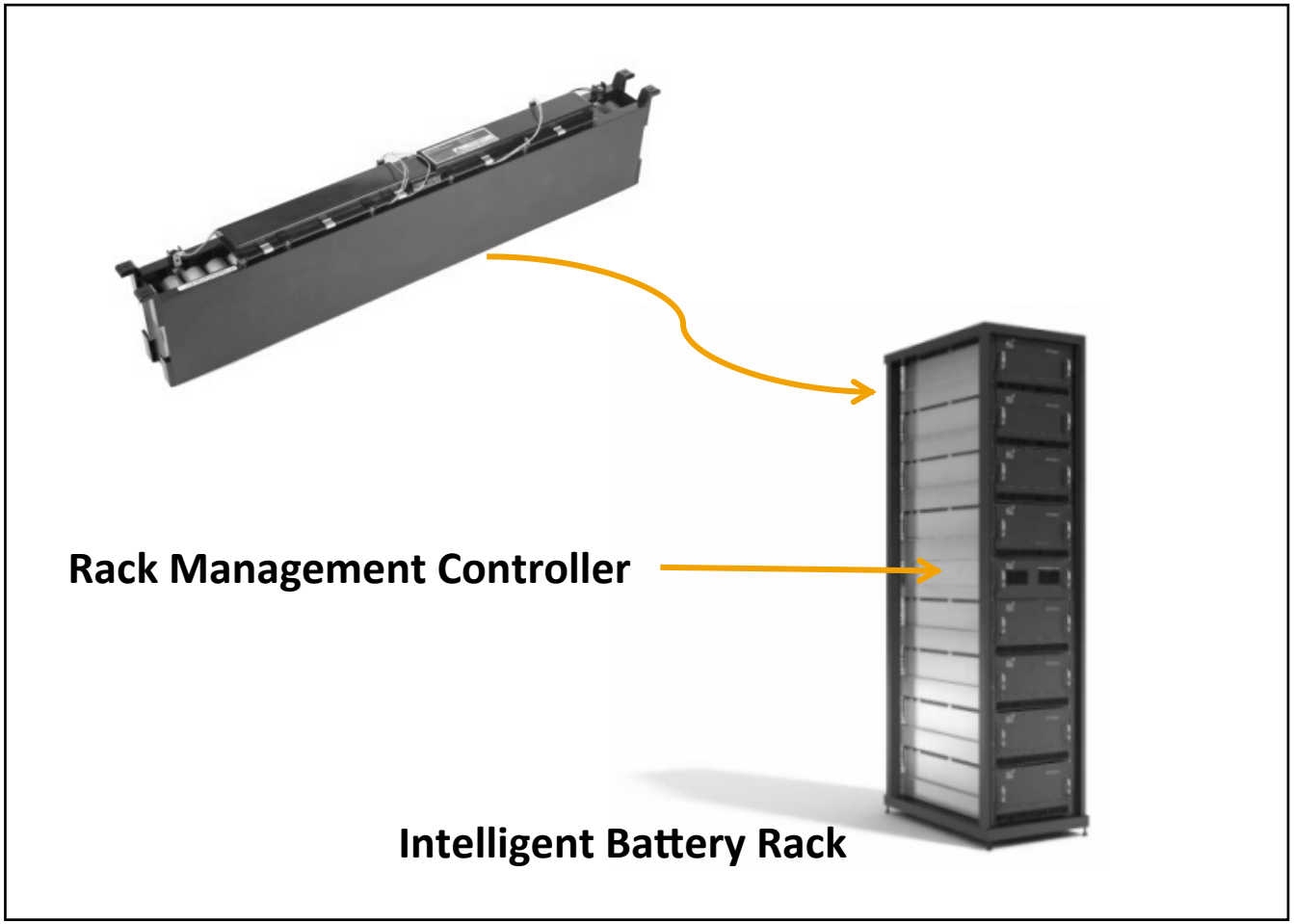
Material Handling

Industrial Controls

- Improve performance
- Lighter weight
- Lower total cost of ownership over lead acid

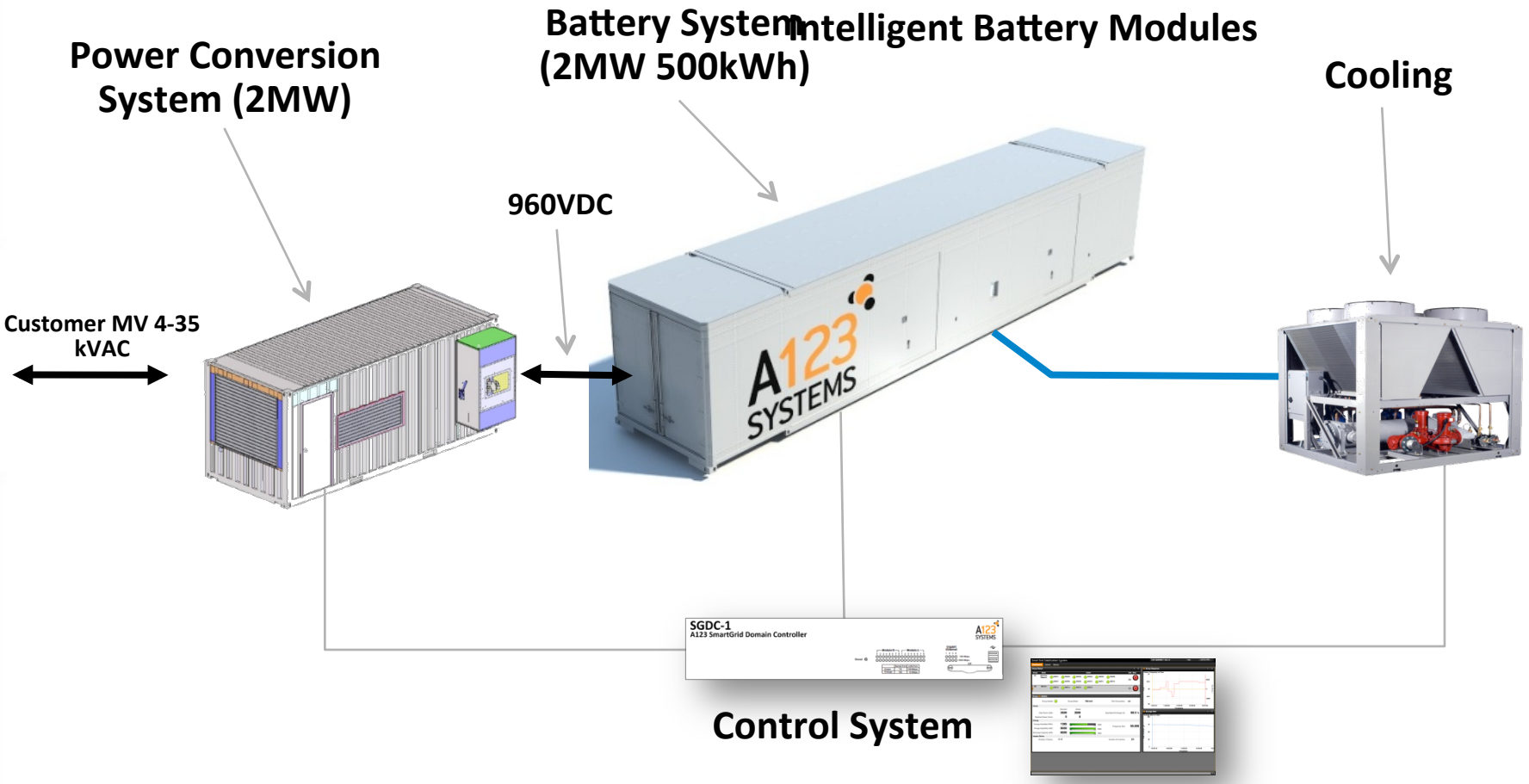
Drivers

Building Block

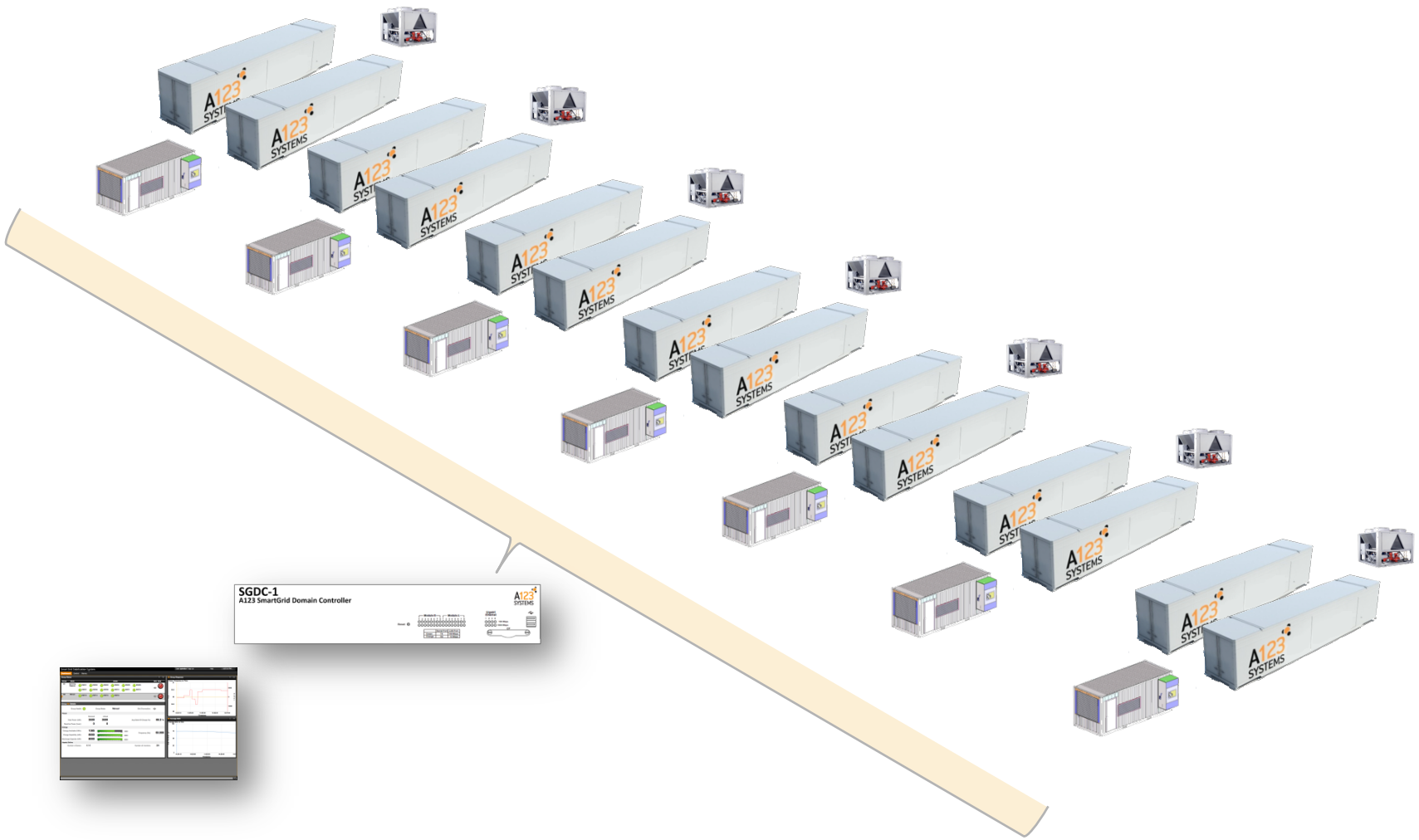


System Overview

System consists of 4 major subsystems

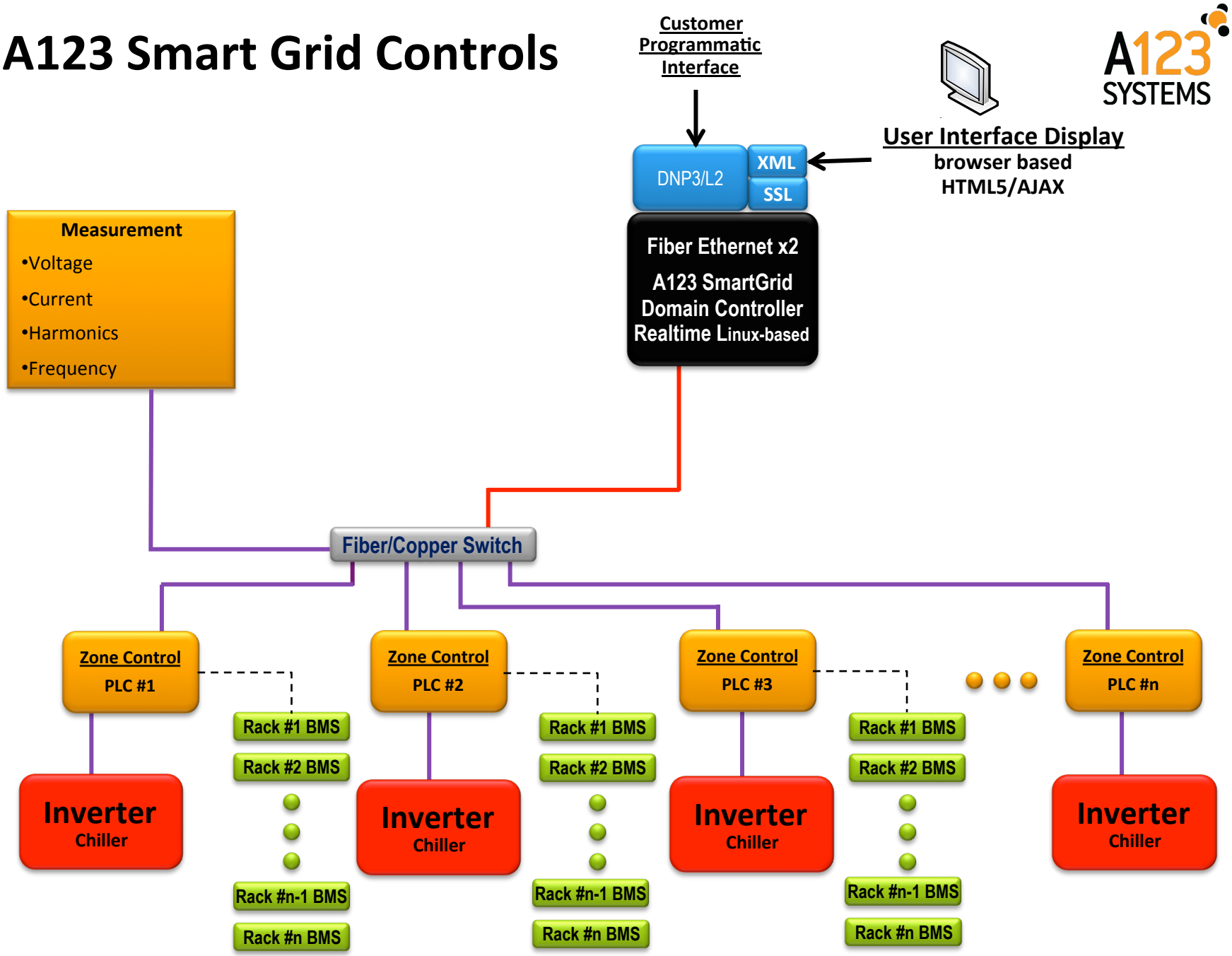


Scalable Architecture from 100kW to 100's of MW



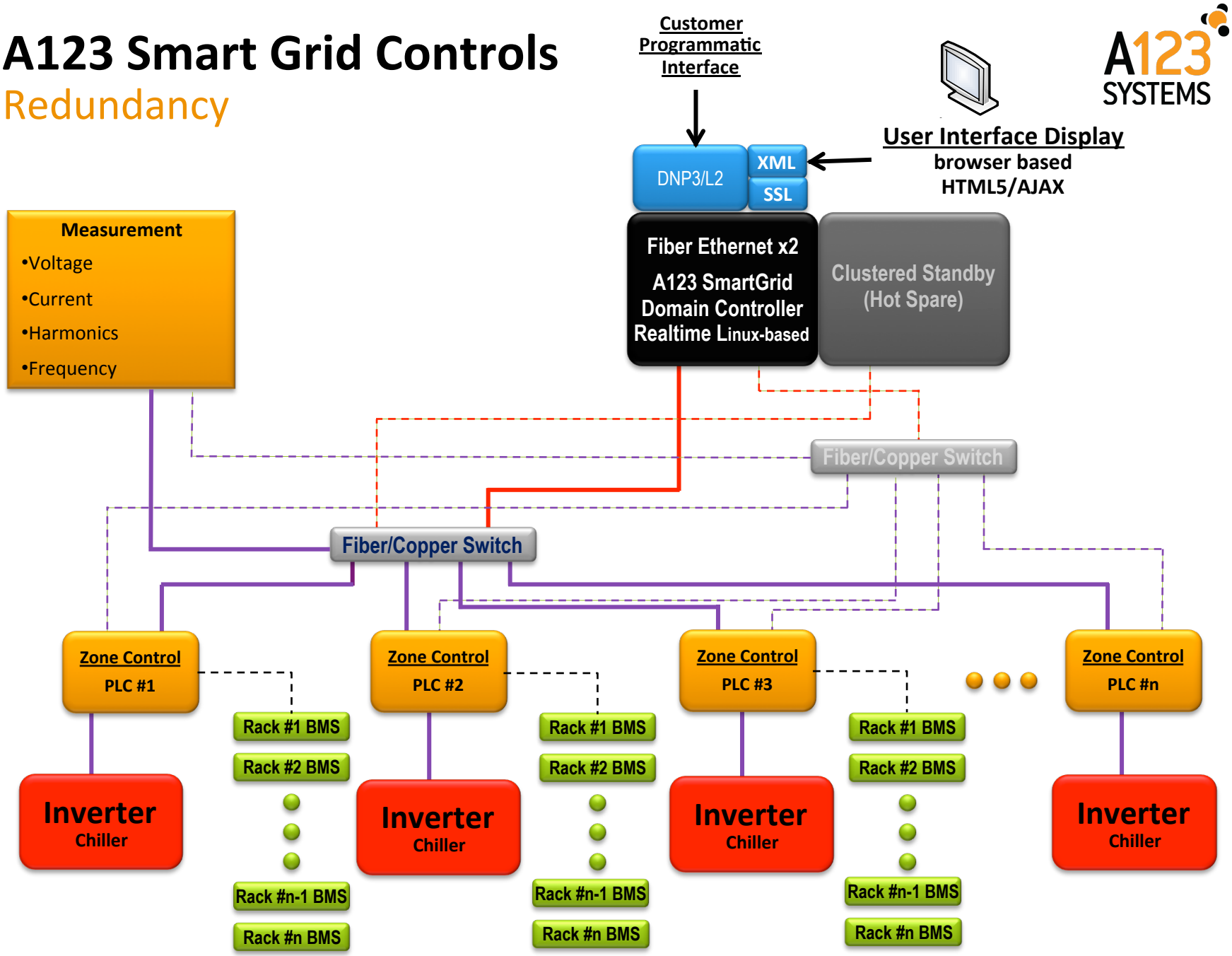
Building-Based Wind Integration

A123 Smart Grid Controls

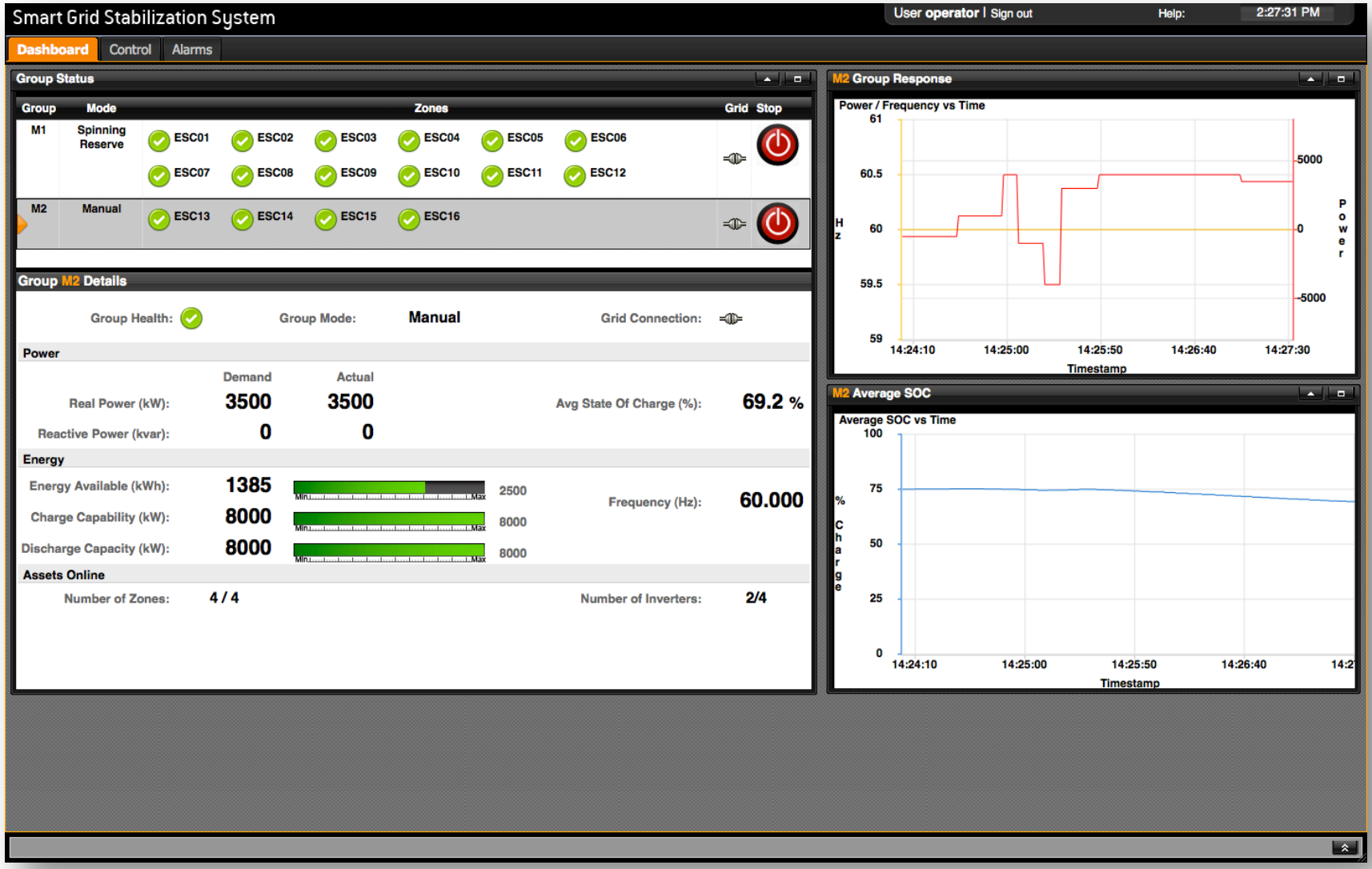


A123 Smart Grid Controls

Redundancy



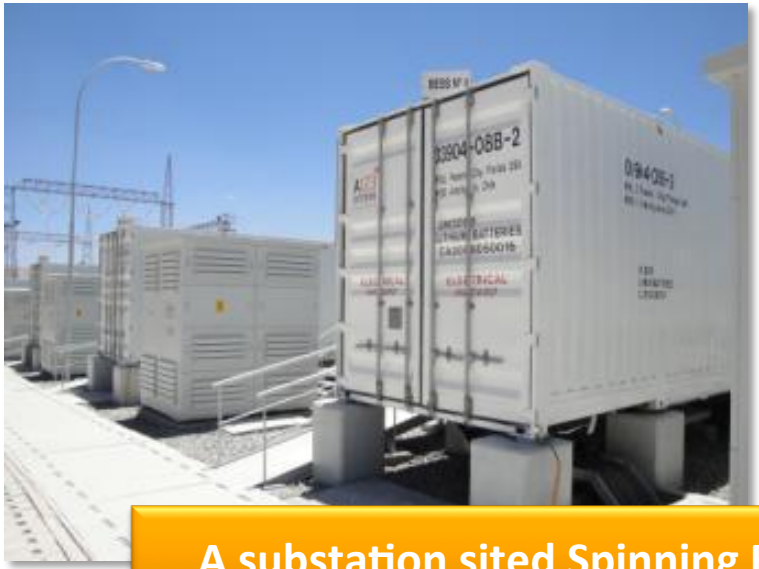
Smart Grid Domain Controller Dashboard



Application Review
Spinning Reserve: Chile

The Problem:

- Fragile power system increases risk of loss of production for area mines, driving high generation reserve requirement



A substation sited Spinning Reserve solution

The Solution:

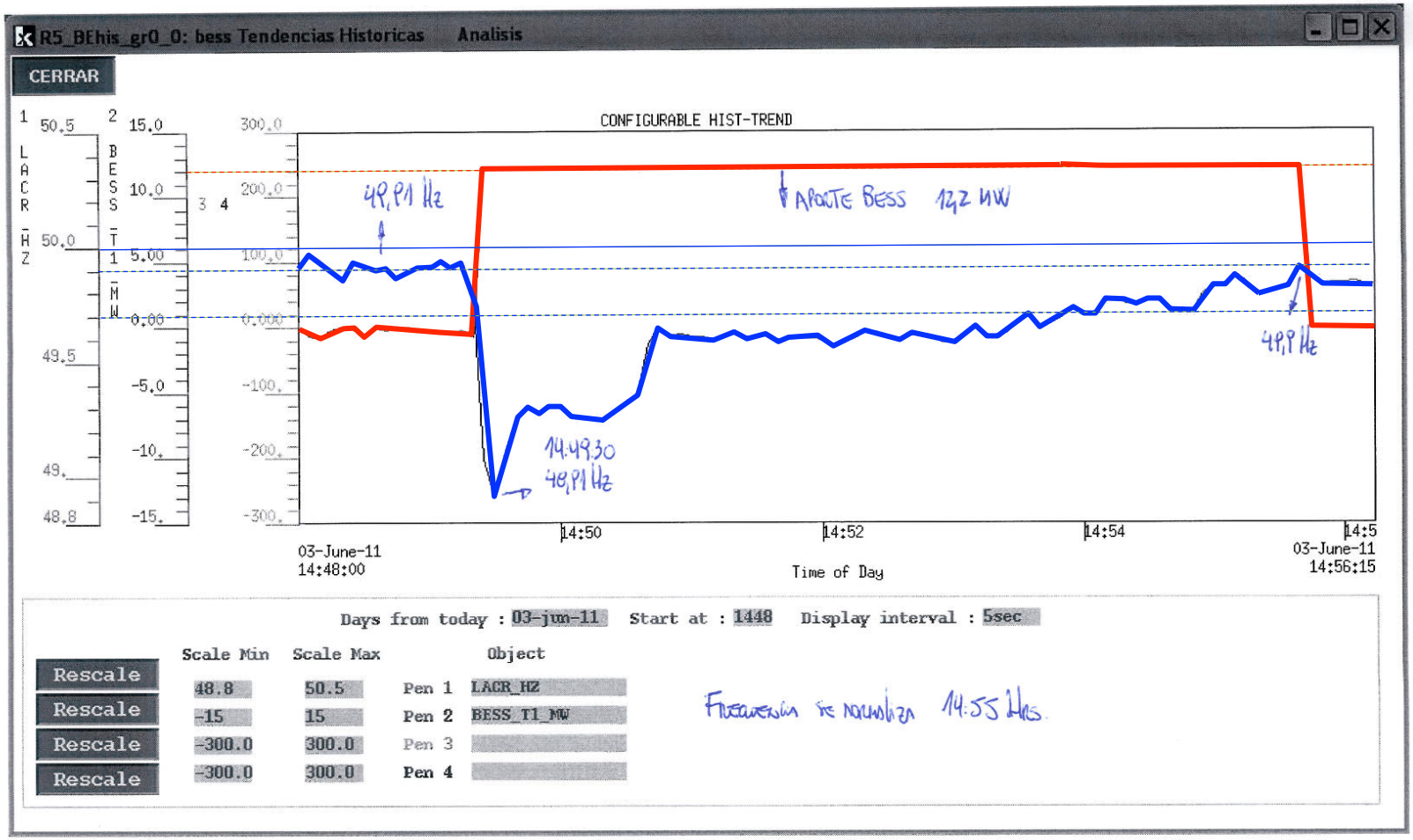
- 12 MW storage in eight packaged systems replaced unpaid generating reserve, freeing up this generating capacity for paid energy service.
- In commercial service with < 3 year payback

AES Chile 2009: 12 MW Grid Stabilization & Generation Capacity Release

Photo courtesy of AES

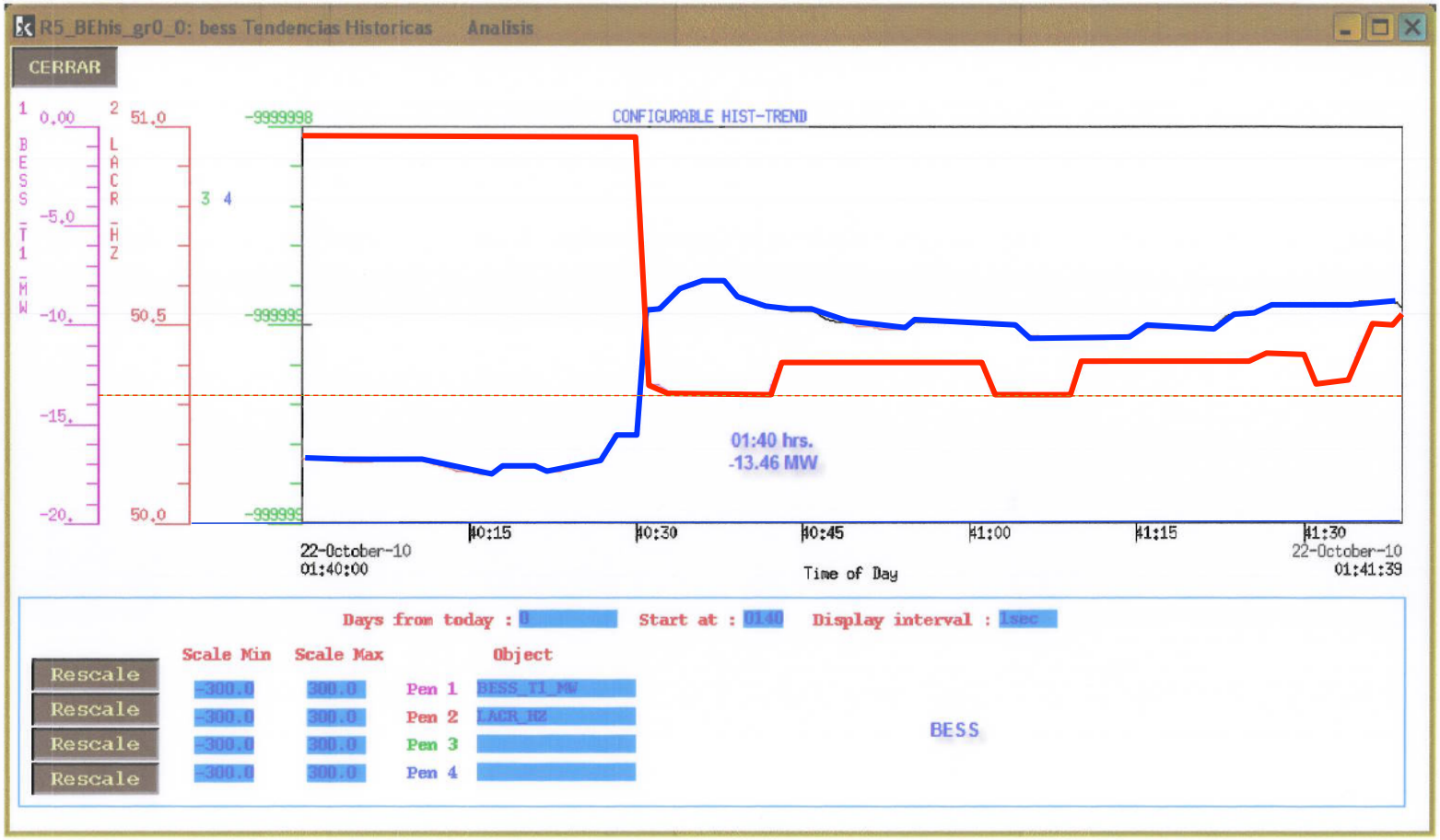
Autonomous Response to Loss of Generation

CDEC-SING Fault Report No. 2777, June 3, 2011



Response to Loss of Transmission (Load)

CDEC-SING Fault Report No. 2580, October 22, 2010



Operational Results

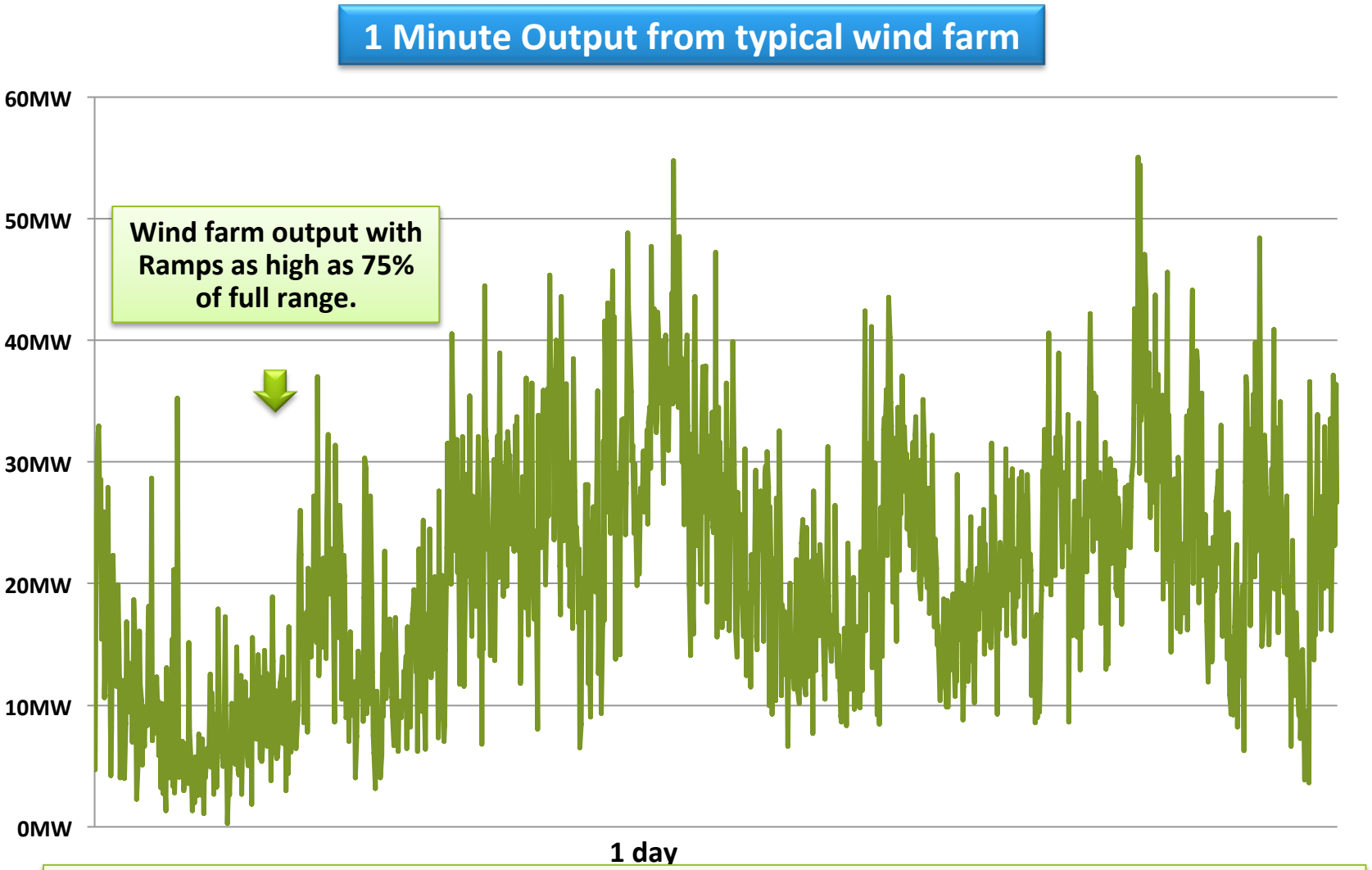
Faster, more consistent fault response through software

- High Reliability and Performance
  - Responded to all generator assisted fault recoveries since Jan. 2010
  - 209 reported faults in 2010
  - Only unit to respond this consistently
  - Response speed consistently higher than other units
- Improved thermal generator efficiency
  - Power previously required to be held in reserve can now be sold
  - Increase power generation by 4 percent
- Highly Configurable
  - Speed and shape of response are programmable via SGDC

Application Review
Wind Ramp Management: Denmark

The Problem:

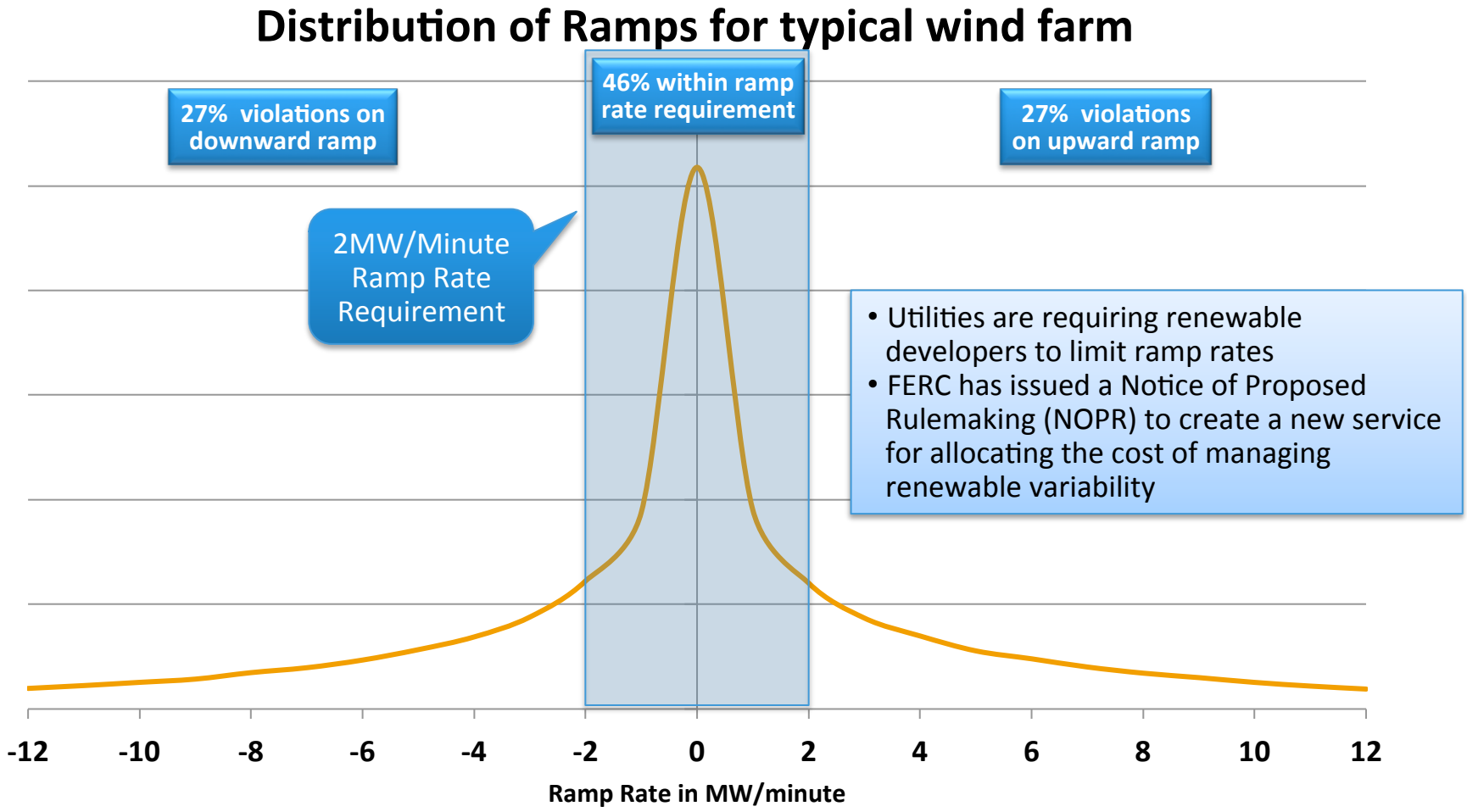
Renewable Output is Highly Volatile



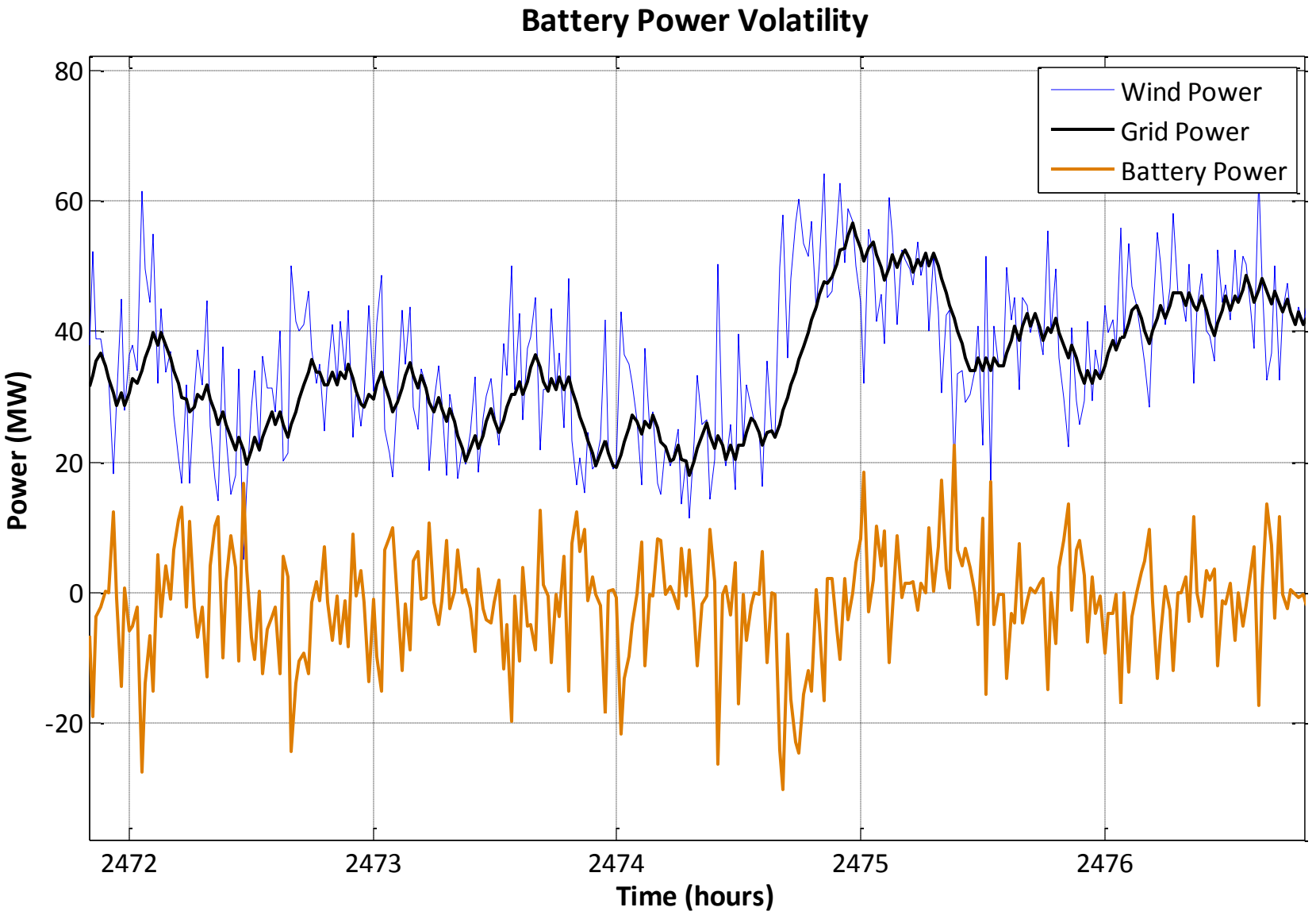
Definition of Ramp Rate: The speed at which the output of a resource changes

Magnitude of the Ramp Rate Problem

Ramp Rate Distribution for Each Minute

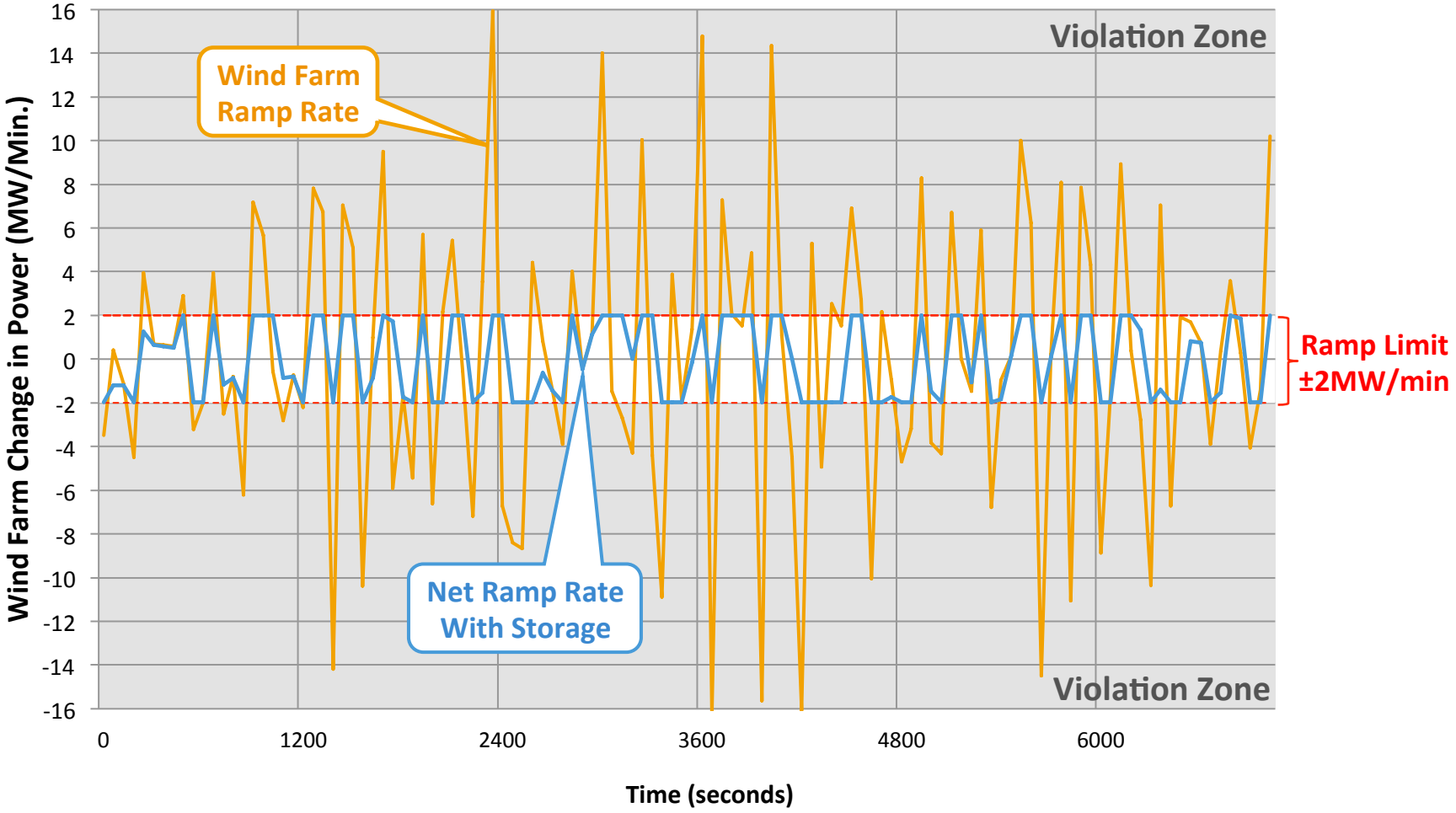


Battery System Performance



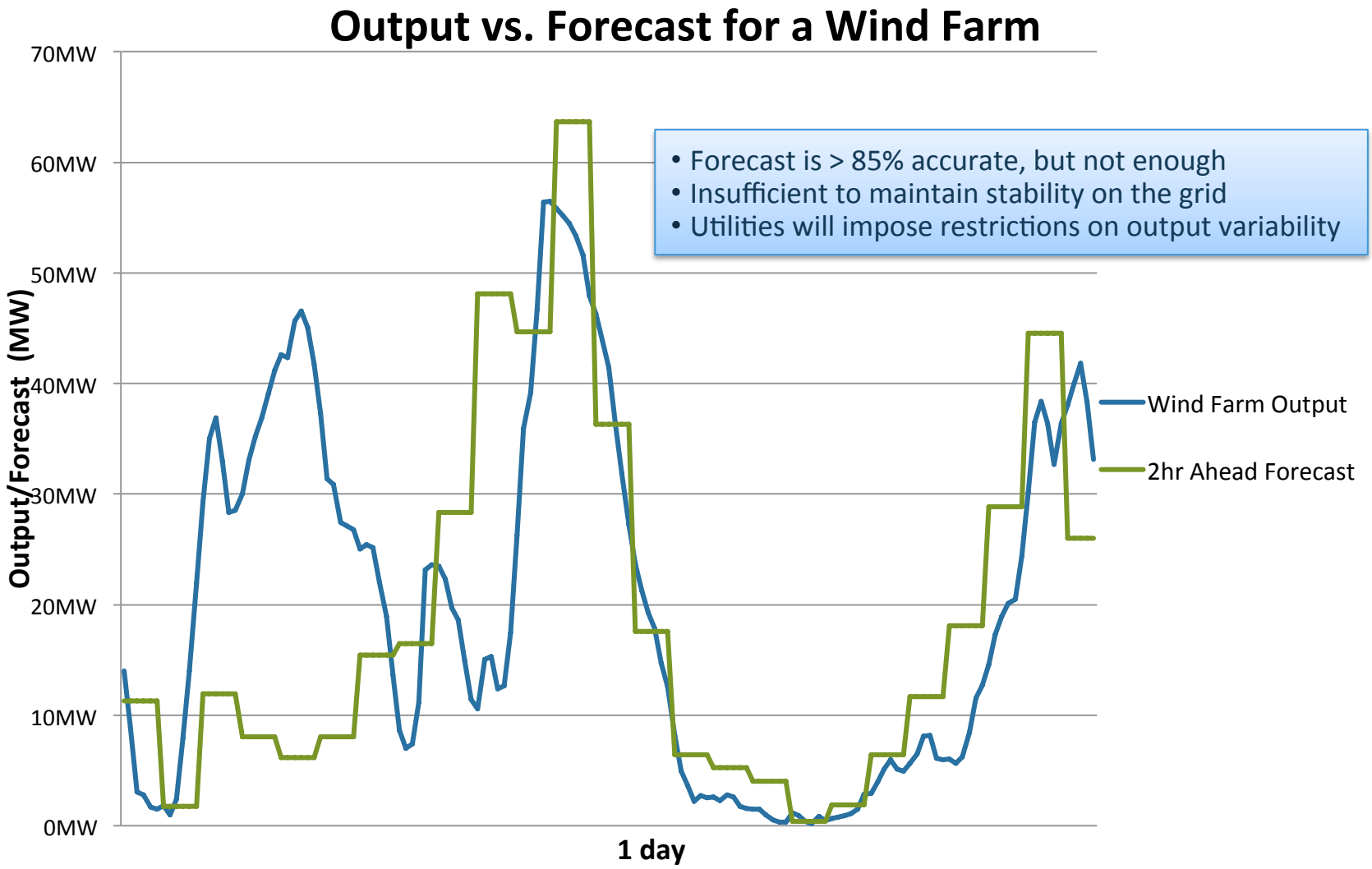
Application Review
Wind Ramp Management

The Problem: the Intermittent output from Wind and PV plants challenges the utility's ability to balance supply and demand. Interconnect approval requires ramp management.

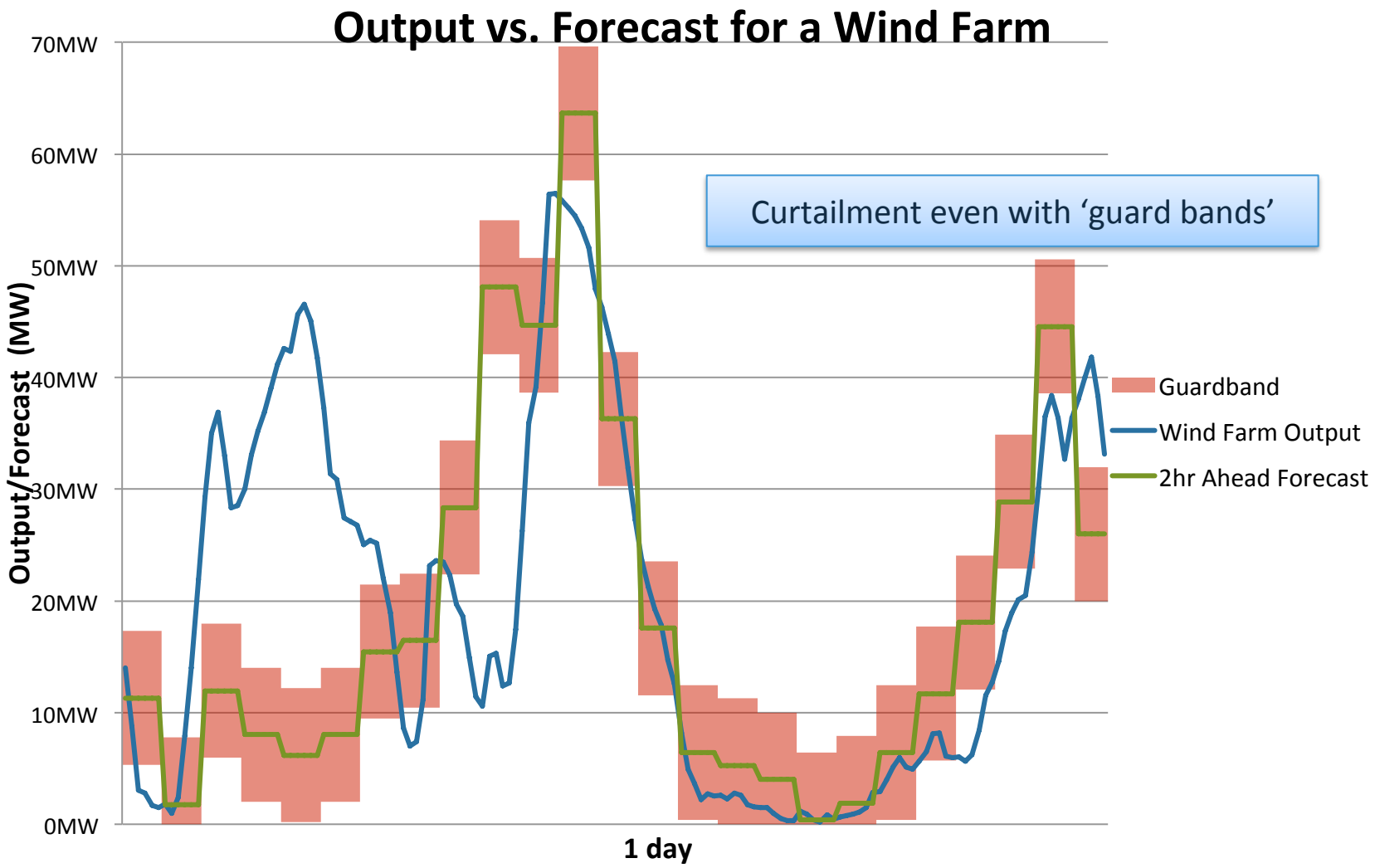


The Problem

Renewable Output is Unpredictable



Using Storage to “Firm” the Wind Farm Output



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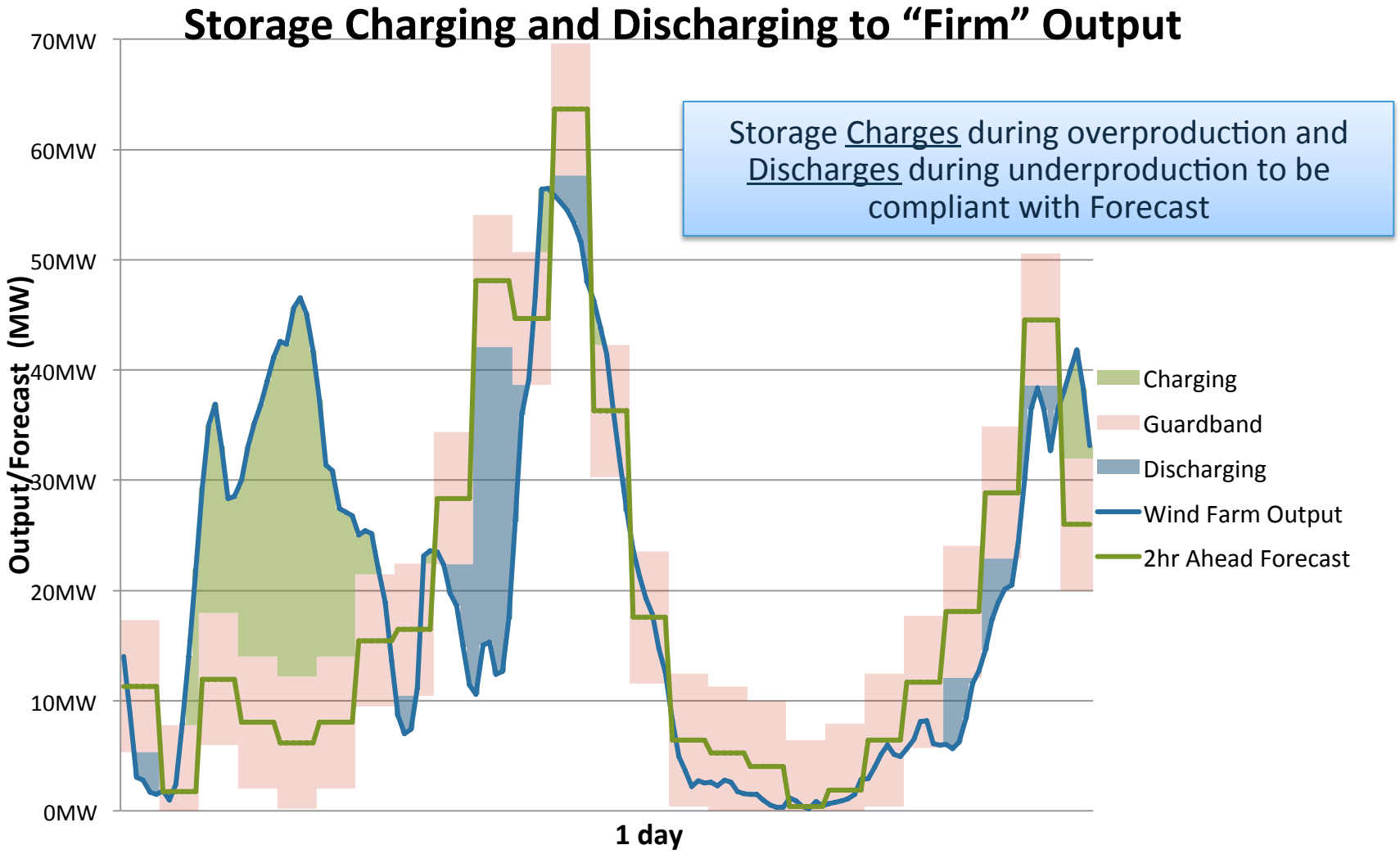
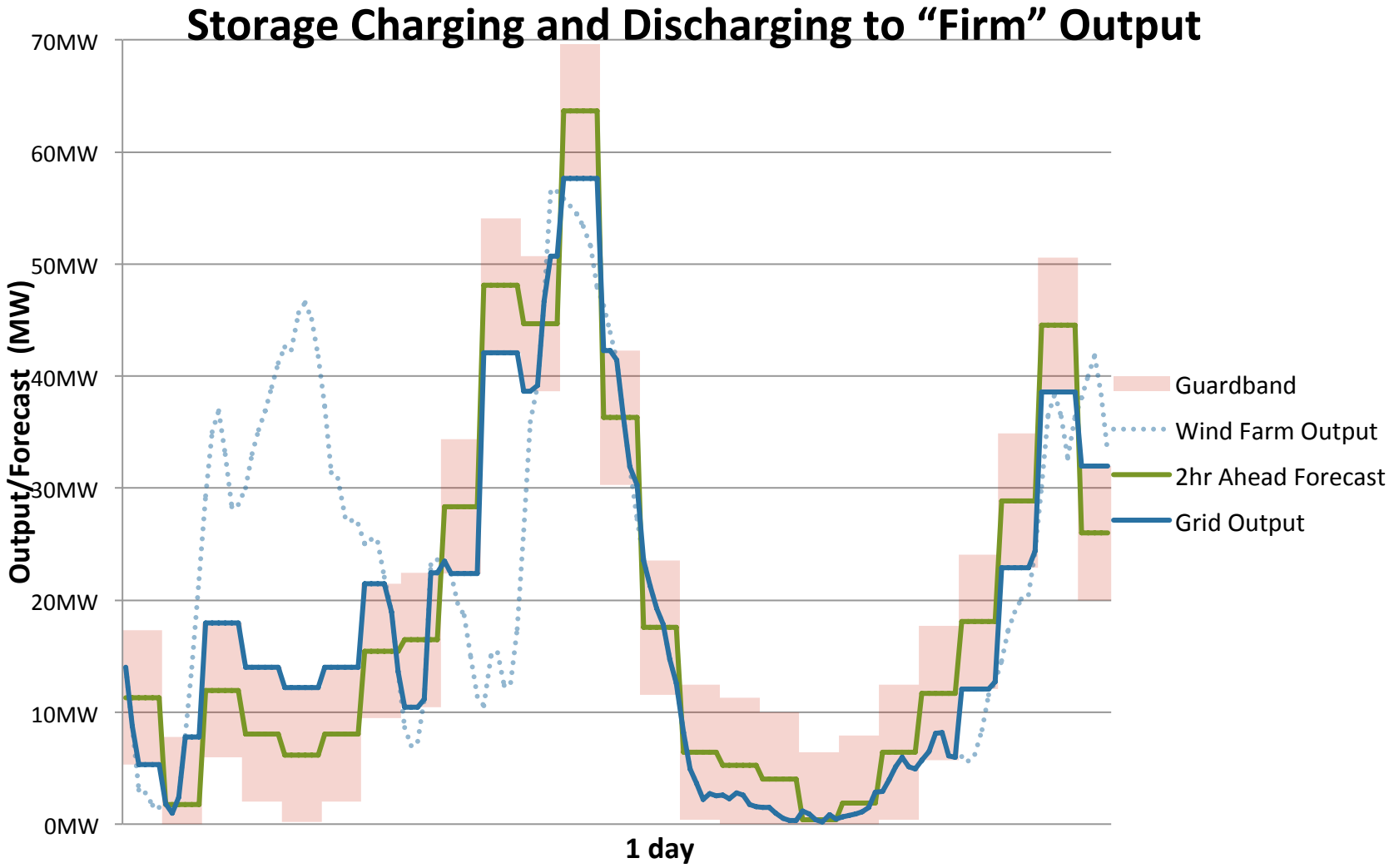


Resulting Grid Output is Firm

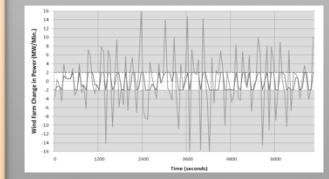


Conclusion

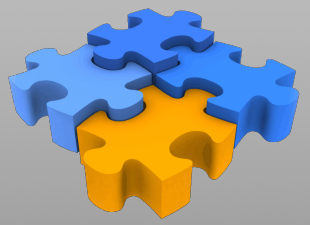
Background

Architecture

Performance



Conclusion



Conclusion

- A123's SGDC has proven the value of end point software through 18 months of ultra-fast spinning reserve calls
- End point control systems and software optimize storage asset and generation utilization based on local measurements
- Efficiency gains can be realized from software at grid end points in conjunction with central dispatch

Summary of Efficiency Gains

Examples of gains that can be achieved by Grid Storage:

- Make renewable resources more predictable to improve their value on the grid
- Reduce the ramp rate of renewable resources to limit negative impact on the grid
- Increase output of traditional generators by freeing up reserve capacity
- Improve efficiency of traditional generators by offloading variability of demand to a fast response storage resource

Why autonomous distributed resources

- Dramatically improve response time by placing storage resource at the point of potential grid disturbance to permit sub second response
  - Proximity reduces the lag time of response and results in more accurate compensation for grid events. As a result, one can achieve more compensation with fewer resources.
- Reduce overall system complexity by distributing the problem into discrete components/chunks
- Distributing fast response resources results in more predictable grid participants at points where resources are placed, making central dispatch for macro grid events less complicated.

Thank You!
Questions?

For more information, please contact:

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